October 1956

ARS-42-5

UNITED STATES DEPARTMENT OF AGRICULTURE
Agricultural Research Service
Agricultural Engineering Research Branch

Wind and Snow Loads on Farm Structures

The information presented here was abstracted from Building Materials and Structures Report 109, published by the National Bureau of Standards, April 1948, and from "Wind Loads on Farm Buildings" published in Agricultural Engineering, January 1947.

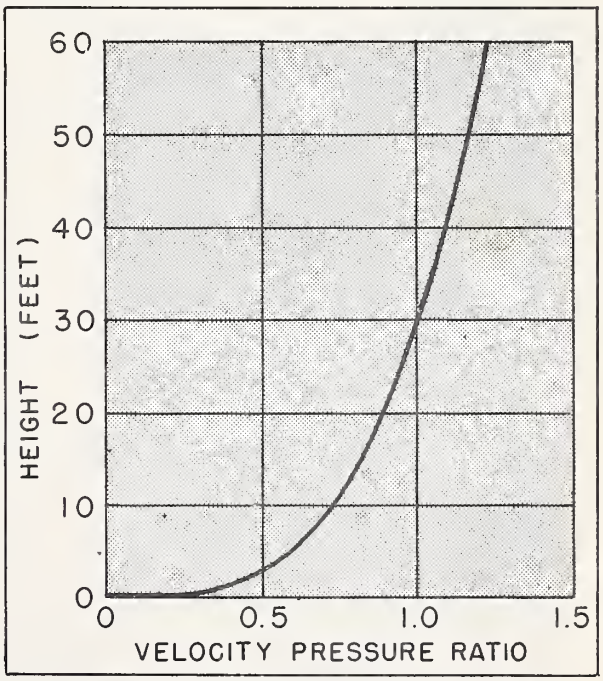
● Pressure exerted on a building by wind is governed by many factors, such as wind velocity, atmospheric pressure and temperature, height and shape of the building and its orientation in regard to the air stream. External surroundings, such as hills, trees and adjacent buildings also have a significant effect.

The wind map, fig. 1, page 2, shows maximum velocity pressures 1/ for the United States based on the maximum average wind velocity for a 5-minute interval as reported by the U. S. Weather Bureau plus 50% gust. The pressures for any given location may be interpolated along the shortest line through that location between isograms or an isogram and a point having different values. The pressures are given for a height of 30 feet above the ground. Graph (A) below provides the ratios for conversion of these pressures to other heights.

The external wind forces on building elements vary with their orientation toward the air stream and height above ground. Table A, page 4, shows the average distribution in terms of velocity pressure q on walls, roofs and eaves.

1/ Velocity pressure q, in pounds per square foot equals $0.002558V^2$, where V is true wind speed in miles per hour, the barometric pressure is 29.92 in. and the temperature 59°F.

Thus a 20 lb. per sq. ft. velocity pressure corresponds to an 88 mph wind, a 30 lb. per sq. ft. velocity pressure to a 108 mph wind and a 40 lb. per sq. ft. velocity pressure to a 125 mph wind.



(A) —Relation of wind velocity and velocity pressure to height above the ground.

[The values are ratios of value at 30 ft.]

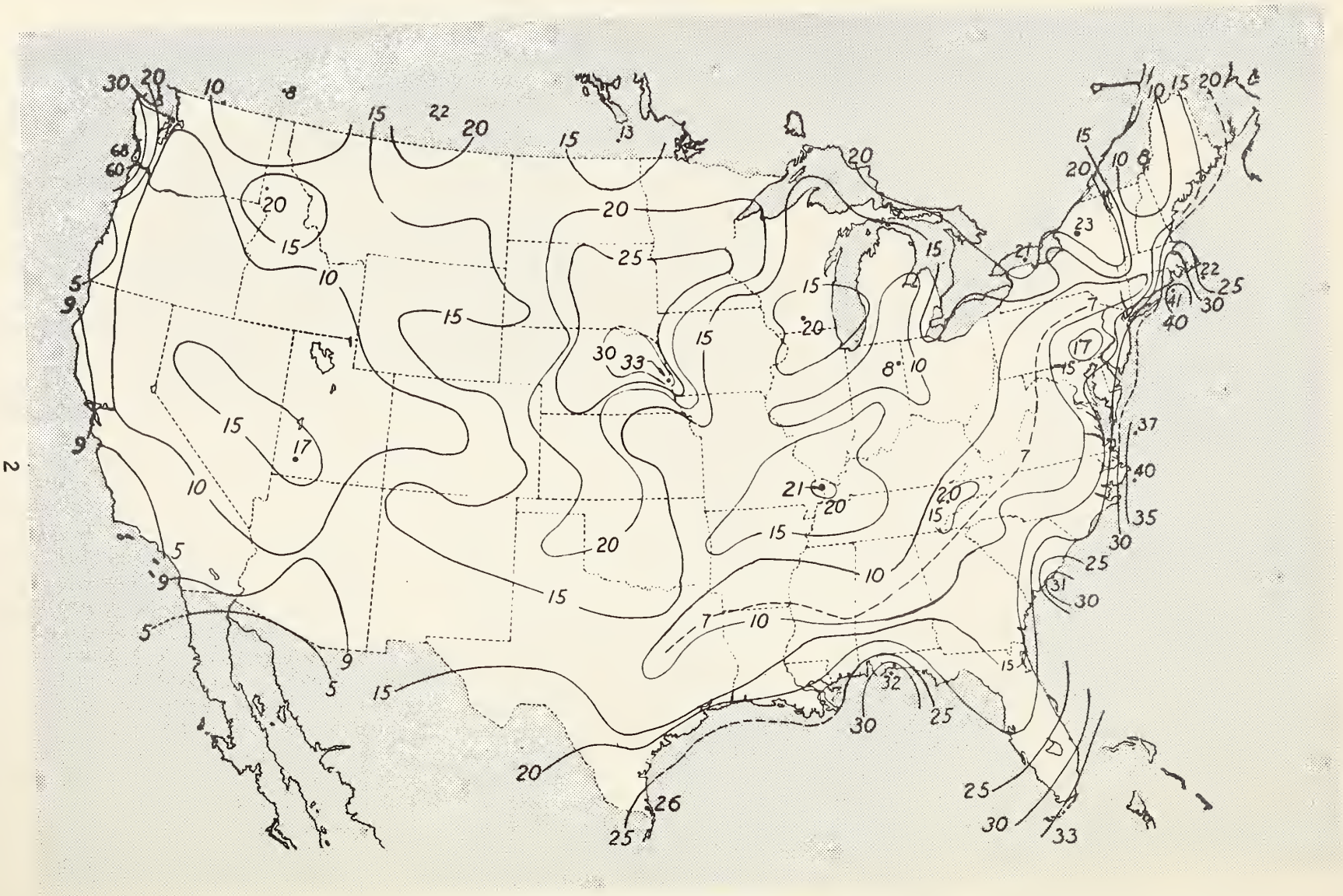


FIG. 1 WIND MAP

(Isograms are maximum velocity pressures, pounds per square foot, at height of 30 ft. above ground.)

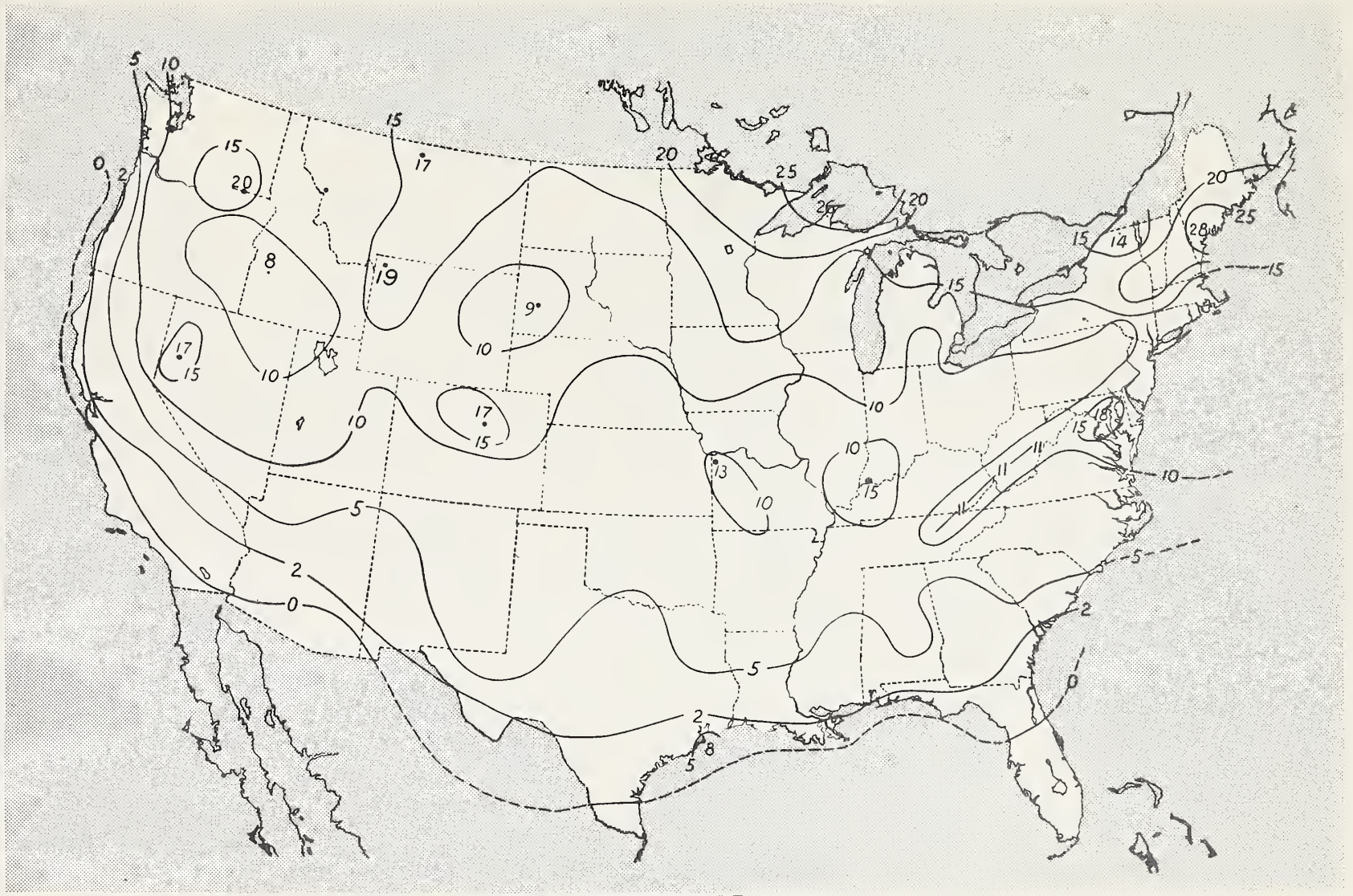


FIG. 2 SNOW MAP

(Isograms are basic snow load, pounds per square foot.)

Table A.- Average distribution in terms of velocity pressure q, on walls, roofs and eaves

Building element	Orientation	Velocity pressure
Walls	Windward	0.80 q pressure
"	Leeward	0.50 q suction
"	Parallel	0.58 q "
Roofs	Windward	
"	0 to 20° slope	0.77 q suction
"	20 to 30° "	0.77 q to zero suction
"	30 to 60° "	0 to 0.58 q pressure
"	60° and over	0.58 q pressure
"	Leeward, flat	0.77 q suction
	" sloped	0.58 q "
"	Parallel, any slope	0.77 q "
Eaves	Maximum pressure up	1.57 q
"	" " down	1.16 q

The wind forces shown in Table A above are based on a windtight building. Loads from internal wind forces must be added for buildings with openings or potential openings such as windows or doors. For buildings having 30% or more wall openings in windward side add 0.77 q pressure out on roofs and walls, and for 30% wall openings in leeward or parallel sides add 0.58 q suction in. Thus, in a building with these openings in the windward side the outside pressure on the windward wall will be neutralized by the inside pressure and the suction on the leeward wall will be increased by the inside pressure.

A similar transfer of forces to the solid walls occurs when openings are in the leeward or parallel walls.

The roof, depending on its slope, will be similarly affected. For openings between 0 and 30 percent of wall area, substitute proportional additional loads.

● Weight of snow accumulated on a roof varies with the geographical location and altitude of the site and the slope of the roof.

The snow map, fig. 2, page 3, shows the snow load in pounds per square foot, based on data reported by the U. S. Weather Bureau. The loads for any given location may be obtained by interpolation, as for the wind map. These loads differ to some extent from those recommended by various authorities 2/ especially in the more northern localities.

The figures given are for flat roofs. Because snow will slide or be blown from sloping roofs, the snow load on the horizontal projections of sloping roofs becomes less as the pitch increases.

The snow load should be taken at 100% for slopes of 20° or less, diminishing uniformly to zero* at 60°, provided there are no snow guards.

---

* As sleet may freeze to a roof regardless of slope, a snow load of 5 to 10 lbs. per square foot (horizontal projection) should be considered as minimum in all except Southern and Pacific States.

2/ Ketchum..... Structural Engineers' Handbook
Kidder-Parker..... Architects' and Builders' Handbook
Hool..... Elements of Structures
Merriman-Wiggin... Civil Engineers' Handbook